

PUBLIC ROADS

A JOURNAL OF HIGHWAY RESEARCH



UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS



INDEX TO VOLUME 19

MARCH 1938-FEBRUARY 1939

CONTENTS OF VOLUME 19

		Page			Page
MARCH 1938:			SEPTEMBER 1938:		
FINANCING OF LOCAL ROADS AND STREETS...	1		HIGHWAY TUNNELS IN WESTERN STATES.....		125
SNOW REMOVAL AND ICE TREATMENT ON			OCTOBER 1938:		
RURAL HIGHWAYS.....	9		THE EFFECT OF USING A BLEND OF PORTLAND		
AUTOMOBILE PURCHASES BY FARM FAMILIES..	13		AND NATURAL CEMENT ON THE PHYSICAL		
APRIL 1938:			PROPERTIES OF MORTAR AND CONCRETE..		153
RURAL AND URBAN CONTRIBUTIONS TO HIGH-			DISPOSITION OF STATE MOTOR-FUEL TAX		
WAY TRAVEL AND EXPENDITURES.....	17		RECEIPTS, 1937.....		167
MAY 1938:			DISPOSITION OF STATE MOTOR-VEHICLE RE-		
AN ACTION PROGRAM TO ADVANCE SAFETY			CEIPTS, 1937.....		168
ON THE HIGHWAYS.....	33		DISPOSITION OF STATE MOTOR-CARRIER TAX		
AN AUTOMATIC RECORDER FOR COUNTING			RECEIPTS, 1937.....		169
HIGHWAY TRAFFIC.....	37		DISPOSITION OF RECEIPTS FROM STATE IM-		
JUNE 1938:			POSTS ON HIGHWAY USERS, 1937.....		170
REPORTS SUBMITTED TO THE INTERNATIONAL			NOVEMBER 1938:		
ROAD CONGRESS BY REPORTERS FOR THE			A STUDY OF SAND-CLAY MATERIALS FOR		
UNITED STATES.....	53		BASE COURSE CONSTRUCTION.....		173
PROGRESS IN THE USE OF CEMENT IN			REFLECTOR BUTTONS INSTALLED ON MICHIGAN		
ROAD SURFACES.....	53		HIGHWAY.....		187
DEVELOPMENTS IN BRICK PAVEMENTS			DECEMBER 1938:		
IN THE UNITED STATES.....	58		PRINCIPLES OF SOIL MECHANICS INVOLVED		
PROGRESS IN THE PREPARATION AND USE			IN THE DESIGN OF RETAINING WALLS AND		
ON ROADS OF TAR, ASPHALT, AND			BRIDGE ABUTMENTS.....		193
EMULSIONS.....	61		JANUARY 1939:		
STATE MOTOR-FUEL CONSUMPTION AND TAX			PROCEDURE EMPLOYED IN ANALYZING PASS-		
RECEIPTS, 1937.....	73		ING PRACTICES OF MOTOR VEHICLES.....		209
JULY 1938:			A SIMPLE PORTABLE AUTOMATIC TRAFFIC		
ACCIDENTS ON THE ROAD.....	77		COUNTER.....		213
SEGREGATION OF THE VARIOUS CLASSES OF			FEBRUARY 1939:		
TRAFFIC ON THE HIGHWAY.....	83		PRELIMINARY RESULTS OF HIGHWAY CAPACITY		
STATE MOTOR-VEHICLE REGISTRATIONS AND			STUDIES.....		225
RECEIPTS, 1937.....	94		COMPARISON OF METHODS FOR DETERMINING		
AUGUST 1938:			THE HILL-CLIMBING ABILITY OF TRUCKS....		233
STUDY AND STANDARD OF QUALITY OF A ROAD					
SURFACE.....	101				
STUDY OF ROAD SUBSOILS.....	112				

LIST OF AUTHORS

BALDOCK, R. H.	PADDOCK, ROBERT H.
CARPENTER, C. A.	PALMER, L. A.
CRAIG, R. E.	PHILLIPS, ROY L.
CRANDELL, JOHN S.	RADZIKOWSKI, H. A.
GLOVER, V. L.	REYMER, S. E.
HOGENTOGLER, C. A.	RUNNER, D. G.
HOLMES, E. H.	SAAL, CARL C.
JASTER, JOHN, JR.	SCHLESINGER, GEORGE F.
KELLERMANN, W. F.	TOMS, R. E.
KELLEY, E. F.	VAN WAGONER, MURRAY D.
MACDONALD, THOS. H.	WILLIAMS, SIDNEY J.
NORMANN, O. K.	WILLIS, E. A.

ABBREVIATIONS

- a.—article(s), report(s)
- fn.—footnote
- r.—reference(s), referred to
- r. to p.—reference(s) to publication(s)

INDEX TO PUBLIC ROADS, VOLUME 19

	Page
A	
Abrasion, resistance of low-cost roads to:	
circular track tests of sand-clay base-course materials.....	173-186, 189, 190
improving, methods of.....	173, 186, 189
<i>see also</i> Stabilization (of soil roads and bases).	
Abrasion loss of brick (paving), rattler test requirements.....	58
Abrasion tests of aggregates:	
Los Angeles abrasion tests.....	64
wear test data for aggregates used in test concretes containing blended cements.....	154
Abrasives, use in ice treatment of roads.....	10, 12, 13, 15
Absorption tests:	
of aggregates used in concretes containing blended cements.....	154
of mortars containing blended cements.....	153
of soil-emulsion mixtures, method and apparatus.....	154, 157-159, 165
Absorptive properties:	
of concrete, data for vibrated pavement concrete.....	57
of soils, data for soils in subgrade soil groups.....	112
<i>see also</i> Moisture content of soils.	
Abutments (bridge), principles of soil mechanics involved in design of, a.....	193-207
Acceleration tests of motor trucks.....	233-239
Accident squads (police).....	35
Accidents, highway:	
accident expectancy formulas.....	77, 78
accident reduction programs and organizations sponsoring.....	33-36, 51, 77-82
accident reporting.....	33-35, 77, 80, 81
accidents on the road, report submitted to Road Congress.....	77-82
at intersections—	
comparative data for signalized intersections and—	
grade separations.....	92
traffic circles.....	92
relation to intersection design.....	91-93
bicycle accidents.....	87
case histories, r. to p.....	33, 35
causes, investigations.....	33-36, 51, 77-82
distribution—	
by day and by night.....	77, 78, 187
by days of the week, Sunday driving.....	79
by hours of the day.....	79
fatalities.....	33
investigation at accident scenes.....	35, 36, 77-79, 82, 87, 89, 102, 187
Massachusetts data.....	33-35, 78, 79
Michigan data.....	89-91, 93
New Jersey data.....	187
on dry roads in clear weather.....	85-87, 92
pedestrian accidents.....	78
Pennsylvania data.....	35, 78-82, 86-91, 93
preventive measures.....	89
segregation of classes of vehicles on highways.....	83-93
use of reflector buttons.....	187-189
<i>see also</i> Signs and signals, traffic.	
relation to—	
road conditions and design.....	36
traffic lanes (number, width, contiguity).....	77-93, 102, 105, 187
skidding accidents.....	83-85, 90-93
statistics, bases of and their unification.....	102, 105
<i>see also</i> Safety (highway safety).	77-82
Administration:	
collection and administration expenses, allocations for, from various State tax receipts, 1937.....	167-170
of highways—	
administrative units in United States.....	2, 3, 7
centralization of.....	1-8
control of snow removal work on rural roads.....	12
financing of local roads and streets, a.....	1-8
of motor-vehicle laws.....	34-36, 51, 77-82
Admixtures:	
types used with abrasives in ice treatment of roads.....	13, 106
use in stabilization of soils.....	64, 67, 70, 105, 113-120
Adobe clay soils, stabilization.....	119
Agg. T. R.....	102
Aggregate spreaders, types used.....	68
Aggregates:	
bituminous aggregates—	
protrusion from pavements as affecting glare.....	110, 111
segregation in premix asphaltic treatment of roads.....	107
settling below surfaces constructed with slow-curing oils.....	106

	Page
Aggregates—Continue I.	
bituminous aggregates—Continue I.	
specifications.....	62, 64-66
temperature control in asphalt plants.....	67
types and sizes used—	
in dense-graded surfaces.....	62, 66
in nonskid treatment of roads.....	103-109
in open-graded surfaces.....	62, 65, 66, 107
in surface treatment work, cover stone.....	65, 175
with cut-back asphalts.....	64, 66, 107
concrete aggregates—	
proportions used in—	
base courses of brick pavements.....	72
vibrated pavement concrete.....	57
test data for aggregates used in test concretes containing blended cements.....	153, 154, 159
in cement-bound macadam roads, types used.....	71
in pneumatically applied mortar used in tunnels, segregation of, prevention.....	140
in sodium chloride treated soil surfaces, protrusion of, correction method.....	118
in soil road surfaces and soil bases—	
properties influencing stability of soil mixtures.....	112-114
specifications, proposed.....	113, 189
loose aggregates on road surfaces as affecting skid resistance of surfaces.....	105
waste sizes, use in soil stabilization.....	113
Air, compressed, <i>see</i> Compressed air equipment.	
Air curing of mortars and concretes containing blended cements, strength data for specimens.....	154-161, 165
Air-cushion joints in concrete pavements.....	56
Air switches for use with traffic detectors, traffic recorders.....	50, 211-230
Alignment of highways and influence of.....	84-86, 116, 187, 209, 212, 221, 225, 240, 241
Aluminate (tri-calcium), limitation of amount in cement.....	55
American Association of State Highway Officials:	
classification of highways.....	83
highway safety activities.....	79
Analyzers, carbon monoxide.....	147-150
Anderson, A. A.....	77, 82, 121
Apparatus, testing, <i>see</i> names of tests and names of materials tested.	
Arizona roads, nonskid construction of.....	107
Ash requirements for distillation residues of emulsified asphalt.....	63
Asphalt joint fillers for brick pavements.....	59, 60, 72, 105
Asphalt plank surfacings, skid resistance tests.....	102
Asphaltic concrete roads, <i>see</i> Bituminous concrete roads.	
Asphaltic films, translucent, r. to p.....	70
Asphalt(s):	
definition.....	61
r. to p.....	70, 71
report to Road Congress.....	61-71
<i>see also</i> names of asphaltic materials—also headings beginning Bituminous.	
Autoclave tests of cement.....	55, 154, 159, 165
Automatic traffic recorders.....	37-51, 210-221, 225
Automobiles:	
automobile purchases by farm families.....	13-14
<i>see also</i> headings beginning Motor.	
Automotive Safety Foundation, highway safety program.....	34, 51, 79, 81
B	
Backfills:	
in highway tunnel construction.....	126
pressures against retaining walls.....	127, 131, 134, 141, 143
Baldock, R. H., a.....	201
Base courses:	
of bituminous surface treated roads.....	65
of brick pavements, materials and construction methods.....	70, 120, 173-186, 189, 190
of low-cost roads—	
equipment used in construction of.....	67
materials for—	
sand-clay materials, study of.....	69, 116-120
specifications, recommendations.....	113
stabilized materials, stabilized soil bases.....	114, 189
of nonskid bituminous roads in Oregon.....	64
65, 67-70, 112-120, 173-186, 189, 190	
108, 109	

	Page
Base stone of penetration macadam roads, sizes, Oregon practice.....	109
Batching of concrete as facilitated by use of bulk cement.....	55
Bearing power, <i>see</i> Supporting power.	
Bed courses of brick pavements.....	58-60, 72
Belt-line roads, bypass roads.....	85-88, 90, 93
Bibliographies:	
bituminous materials, use.....	70-71
finance, highway, publication notice.....	221
safety, highway, publication notice.....	30
Bicycle tracks, segregation.....	53, 87, 93
Binders, binding materials:	
binding qualities of soils in subgrade soil groups.....	112
types used in—	
mastic bed courses of brick pavements.....	59, 60
stabilization of soils.....	67, 112-120
<i>see also</i> names of binding materials.	
Bitulithic pavements, friction coefficients.....	104
Bitumen, definition.....	61
Bitumen content of tars for road use, requirements.....	63
Bituminous concrete base courses for brick pavements.....	60
Bituminous concrete mixtures for repair work.....	62, 108
Bituminous concrete roads:	
construction, Oregon practice.....	108, 109
cracking of, research.....	69, 70
emulsions (asphaltic) for use in.....	62, 63
finishing equipment.....	69
hot-mixed and hot-laid bituminous concrete, r. to p.....	64
light-reflecting properties, glare.....	101, 109-111, 121
skid resistance, nonskid treatment.....	101-109
soft asphalts, use, research.....	70
Bituminous fillers for joints:	
of brick pavements—	
surface-removal method of application.....	59
types used and their relation to bleeding.....	59, 60, 72, 104, 105
of concrete pavements.....	56
Bituminous macadam base courses for brick pavements.....	60
Bituminous macadam roads:	
construction methods and equipment.....	62-64
light-reflecting properties, glare.....	101, 110, 111, 121
skid resistance.....	101-105, 107, 109
Bituminous mastic bed courses of brick pavements.....	59, 60, 72
Bituminous materials:	
bibliography.....	70-71
consumption in United States.....	61, 65, 70
durability.....	69, 70
exudation on road surfaces—	
as affecting skid resistance of pavements.....	101, 193-105, 108, 109
bleeding of joints.....	56, 59, 60, 72, 104, 105
hardness, hardening properties, and certain effects of.....	61, 70, 71, 101, 103, 104, 106
hot materials, use, r.....	64, 65, 67, 104, 106-109
recovery from paving mixtures, methods, r., r. to p.....	70, 71
refining processes as affecting quality of materials.....	69
report submitted to Road Congress.....	61-71
research (laboratory, field).....	69-71
specifications, developments in.....	61-64, 69, 70
tests of.....	62-64, 69-71
use—	
in nonskid treatment—	
of roads.....	101-109
of wood planks.....	105
in stabilization of soil roads and bases.....	62
65, 67-70, 105, 113-116, 119, 120	
Bituminous roads:	
base courses of.....	64
65, 67-70, 112-120, 173-186, 189, 190	
bituminous concrete roads, <i>see</i> Bituminous concrete roads.	
cold-mixed and cold-laid surfaces.....	64, 107
construction methods and equipment.....	61-71
cracking of.....	69-71, 103
dense-graded surfaces.....	62-66, 69, 70, 108
dual type, multiple-lane, bituminous roads.....	63
glazed surfaces, skid resistance.....	84, 93
hot-mixed pavements.....	103, 104, 106
light-reflecting properties, glare.....	64, 67, 107
old bituminous surfaces, surface treatment of.....	101, 109-111, 121
open-graded, open-mix, surfaces.....	65
plant-mix construction.....	62-66
premix construction.....	70, 104, 107-109
r. to p.....	61-70, 108
reinforcement with cotton fabric.....	63, 65, 104, 106, 107
70, 71	

	Page		Page		Page
Bituminous roads—Continued.		Calcium chloride—Continued.		Clays and clayey soils:	
retread asphalt pavements, friction coefficients.....	104, 105	use—Continued.		as binders—	
retread treatment of old roads.....	65	in drying tubes in carbon monoxide analyzers.....	148, 149	in calcium chloride treated gravel.....	118
road-mix construction.....	61-68, 106, 107	in freezing and thawing tests of concrete containing blended cements.....	153, 160-162, 164-166	in soil stabilization.....	67, 105, 113, 116, 120
sheet asphalt roads.....	64, 69-71, 104-106	in stabilization of soils.....	113, 117, 118	as undersols of retaining walls and bridge abutments.....	201, 204, 206
skid resistance, nonskid treatment.....	101-109	on icy roads.....	13, 106	characteristics, data for soil groups.....	112, 113
softening if constructed with slow-curing oils.....	106, 107	Cane fiber as joint filler in concrete pavements.....	56	heating of, before use in soil stabilization.....	113
wet roads and dry roads, friction coefficients of.....	101-105	Cantilever tests of mortars containing blended cements.....	154	sand-clay base courses—	
Bituminous surface treatment of roads:		Capacity studies, highway: preliminary results of, a.....	225-232, 240	bituminous surface treatment.....	65
circular track test data.....	173-186, 189, 190	see also Traffic capacities of highways.		study of.....	173-186, 189, 190
in southern States.....	173	Capillary absorption tests of soil-emulsion mixtures.....	115	stabilization, methods and materials.....	113, 119, 120
materials and methods used.....	62, 63, 65, 68, 70, 105, 108, 109, 175	Capillary moisture in soils, relation to stability.....	112, 113, 115, 179	Clearances:	
nonskid surface treatments, friction coefficients for surface treated roads.....	104-109	Carbon disulphide, solubility in—requirements for residues of liquid asphaltic materials.....	62	between passing and approaching vehicles at completion of passing on highways.....	212
road types to which surface treatments are given.....	65	Carbon monoxide gas: in highway tunnels, analyzers and recorders.....	147-150	vertical clearances in highway tunnels.....	131
Blading operations and equipment in construction of road surfaces and bases.....	65-68, 116, 117, 119, 120	Carborundum grit as facing for paving brick for nonskid surfaces.....	105	Climate, climatic conditions:	
Blasting operations and equipment in highway tunneling.....	125, 132, 139, 142-147	Carothers, S. D.....	194, 195	as affecting—	
Bleeding:		Carpenter, C. A., joint author, a.....	173-186, 189, 190	operation of traffic recorders, reduction methods.....	41-43, 218, 219
of bituminous pavements.....	103-109	Carriageways: segregation of classes of traffic on highway, report submitted to Road Congress.....	83-93	requirements for base courses of brick pavements.....	60
of brick pavements.....	59, 60, 72, 104, 105	see also Lanes, traffic.....		as basis of demulsibility specifications for emulsified asphalts.....	63
of concrete as affected by use of blended cement.....	160, 164, 165	Catton, Miles D.....	120	see also Weather conditions.	
Blends:		Cement:		Clock mechanisms:	
of asphalts as fillers in brick pavements.....	60, 105	autoclave tests of.....	55, 154, 159, 165	in traffic recorders.....	37, 41, 210, 211, 219, 220
of cements, effects on mortar and concrete.....	153-166	blends of, effects on mortar and concrete, a.....	153-166	time-distance recorder used in grade tests of trucks.....	234
Blowers, motor-driven, use with rotary brooms in cleaning road surfaces.....	68	bulk cement, handling and use.....	55, 71	Coating tests of emulsified asphalts, requirements.....	63
Bond:		composition as affecting—		Cohesion in soils:	
between bituminous materials and mineral surfaces, r. to p.....	71	durability of concrete.....	55, 56	relation to supporting power.....	193, 196-201, 203, 204, 206
in macadam roads as affected by elastic properties of subsoils.....	112	freezing and thawing of concrete.....	55, 153, 161, 164	replacement of fill soils lacking cohesion.....	116
see also Binders, binding materials.		test data for blended and natural cements.....	153, 154	Collection costs of taxes, see Administration (collection and administration expenses).	
Bonds, highway: funds for from State tax receipts, 1937.....	167-170	use—		Color of pavements, relation to luminosity.....	101, 111
Border roads for access to freeways.....	87	in road surfaces, report submitted to Road Congress.....	53-57, 71, 72	Colorado roads:	
Boulevards.....	90	in soil stabilization.....	113-115, 118, 120	bituminous roads, road-mix construction of.....	107
Braking-effort tests of motor vehicles, friction requirements when braking.....	102	Cement-bound macadam roads:		financing of, financial survey data.....	17-30
Brick, paving:		construction methods.....	71	Compaction:	
broken brick—		slab strength, increase by compaction after grouting.....	71	of base courses and surfaces of low-cost roads.....	64-69, 116-120, 173-186, 189, 190
as aggregate in cement-bound macadam roads.....	71	Cement content of concrete:		of macadam roads—	
limitation in rattler tests.....	58	in base courses of brick pavements.....	72	data for cement-bound macadams before grouting, after grouting.....	71
de-aired brick.....	58, 104	in specimens tested for effects of blended cements.....	153, 159, 161, 164, 166	relation to properties of subsoils.....	112
end lugs, requirements.....	60	practice.....	55-57, 72	compaction—stability relations of bituminous surface treated sand-clay mixtures tested on circular track.....	175-186, 190
flexural strength, tests of.....	58	reduction in vibrated pavement concrete.....	57	compaction to maximum density at optimum moisture content, Proctor method.....	53, 114, 115, 118-120, 174, 175, 181, 182, 186
manufacture.....	58, 104, 105	Cement grouts as joint fillers for brick pavements.....	59, 60, 72	requirements—	
repressed lug.....	58	Cement gun, pneumatic, use in application of mortar in tunnel construction.....	125, 140	field compaction requirements of fill soils in percentages of dry weights.....	116
salvaged brick from old pavements, average proportion.....	72	Cement-hardened earth roads, experiments.....	72	in soil stabilization, determination by use of moisture-compaction curve.....	115
sizes—		Cement rubble masonry portal structures for highway tunnels.....	128, 129, 135, 136	Comparator, horizontal.....	154
for municipal work.....	72	Certificates of title (motor vehicle), receipts from, 1937.....	96, 97	Compressed air equipment, use:	
standard sizes.....	58	Chains, tire, as affecting skidding.....	102	in construction of tunnels.....	125, 139, 140, 142, 143, 145-147
specifications.....	58	Champion, Walter.....	147 (fn)	in moving concrete pavement slabs.....	85
vertical fiber brick.....	58, 60, 104	Channelizing traffic islands.....	88	Compressed soil cylinder, stresses in, analysis of.....	194, 199
vitrified brick.....	58, 60, 72	Chemical admixtures, use in soil stabilization.....	116-118	Compressibility of soils:	
wire-cut-lug.....	58	Chemical analyses of cements used in test concretes of natural and blended cements.....	154	consolidation of compressible soils, foundation problems involving.....	193-207
Brick pavements:		Chemical analyzers of tunnel air, carbon monoxide analyzers.....	147-150	see also Compaction (of soils)—Settlement.	
construction methods.....	58-60, 72, 104, 105	Chemical treatment of icy roads.....	10, 13, 106, 108, 153	Compression tests:	
old pavements, relaying.....	72	Chemistry (surface), research.....	70, 71	of soils.....	198, 199, 204
reinforced brick pavements.....	60, 72	Chips, stone:		see also Compressive strength—Proctor method of compaction.	
report submitted to Road Congress.....	58-60, 72	projection from bituminous macadam surfaces as affecting glare.....	110, 111	Compressive strength:	
skid resistance.....	102, 104, 105	use—		of bituminous paving mixtures, studies.....	70
Bridges, highway:		as cover material in bituminous road construction.....	64-66, 106-111	of concrete, data for—	
abutments, design of, principles of soil mechanics involved in.....	193-207	in nonskid treatment of roads.....	106-108	specimens containing blended cements.....	153, 159-161, 166
floors—		Choke stone, size requirements for open-graded bituminous road-mix surface courses.....	65, 66	vibrated concrete used in tunnel lining.....	140
design of, publication notice.....	190	Chronographs, use in grade tests of trucks.....	234, 235, 238	of mortars containing blended cements.....	153-157, 165
skid resistance tests.....	102, 104, 105	Cinder road surfaces, skid resistance.....	102, 104, 105	Compressive stresses in aggregates in drying mortars containing blended cements, effects.....	157, 158
overhead bridges, overpasses, for pedestrians.....	87, 89, 93	Cinders, use on icy roads.....	12, 13, 15, 105, 106, 108	Concrete:	
use in grade separations.....	87, 89, 93	Circles, traffic, see Traffic circles.		from old pavements, use in cement-bound macadam roads.....	71
Bridle paths.....	87, 93	Circular footings, undersols of, supporting power of, calculation of.....	206	properties as affected by—	
Brine, use in soil stabilization.....	118	Circular track tests of sand-clay base-course materials.....	173-186, 189, 190	composition of cement.....	55, 153-166
Brooming:		Cities:		vibration method of placing.....	57
of concrete pavements, effects upon—		accident squads, establishment in urban areas.....	35	water-cement ratios.....	56
glare, pavement.....	106-111	development as facilitated by State highway systems.....	29	reinforced concrete, use—	
skid resistance, pavement.....	103, 107, 108	Model Traffic Ordinances, adoption of residents of,—taxes paid by, motor vehicles owned by, highway use by.....	17-30	in base courses of brick pavements.....	60, 72
of stabilized soil bases.....	120	safety organizations in, highway streets in, see Streets, city and village.	79-82	in linings of highway tunnels.....	128-132, 137, 141, 143
Brooms and broom drags, improvements in.....	68	traffic lanes, outside lanes, width.....	85	in pavements.....	56, 57
Brown, R. A.....	142 (fn)	traffic surveys in, use of traffic recorders in.....	43, 50, 51	tests of concretes containing blended cements.....	153-166
Busses, motor:		Clay emulsions, formation in machine-mixed materials for soil stabilization.....	120	use—	
accident reduction measures taken by transportation companies.....	79, 80			to fill space behind tunnel linings.....	131
registrations (United States), 1937.....	94-96			to reinforce timbering in tunnel construction.....	141, 143, 147
see also Trucks, motor (and busses).				vibrated concrete, vibrators.....	57, 71, 103, 140, 141
Buttons, reflector, installation on Michigan highway, a.....	187-189				
Bypass roads.....	85-88, 90, 93				
C					
Calcium chloride:					
direct application to concrete surfaces, effects.....	106				
use—					
as dust palliative.....	118				
as separating agent for brick pavements.....	59, 105				
in air storage cabinet for mortars containing blended cements.....	157				
in concrete lining of tunnel.....	141				
in demulsibility tests of emulsified asphalts.....	62, 63				

	Page		Page		Page
Concrete base courses:		Crandell, John S., joint author, a	58-60, 72	Divided highways—Continued,	
of asphaltic concrete roads, resurfaced con-		Crowns, road	12, 108, 117	markers and reflectors installed on (Michi-	
crete roads serving as bases	108	Crushed stone, <i>see</i> Aggregates—Base courses (of		gan)	188
of brick pavements, construction methods	60, 72	brick pavements)—Cover mate-		traffic volume of, relation to speed of ve-	
Concrete bridge floors, skid resistance	105	rials		hicles	229-231
Concrete linings for highway tunnels, reinforced		Crushing strength, <i>see</i> Compressive strength.		Doweled joints:	
concrete linings	126-137, 139-141, 143	Curbs, curbing:		effectiveness in concrete pavements	56, 57
Concrete mixes:		at islands in approaches to traffic circles	91	use in concrete base courses of brick pave-	
mixes used in—		in sidewalk designs	89	ments	60
base courses of brick pavements	60, 72	in tunnels	126-129	Drags, road	68, 117, 118
concretes tested for effects of blended		integral curbs, use on brick pavement proj-		Drainage:	
cements	153, 159, 160, 164	ect	60	of road surfaces and subgrades—	
tunnel linings	140	parking of motor vehicles at	85, 86, 90	as affecting—	
<i>see also</i> Proportioning of materials (in		vertical curbs on dividing strips of multiple-		light-reflecting properties of surfaces	101,
concrete)		lane roads	84	stability	103, 108, 112, 116, 117, 186
Concrete mixing equipment:		Curing:		winter drainage of roads	10-12
dual-drum mixers, use	71	of concrete	71, 141, 159	of tunnels (highway)	126, 127, 133, 134
redesign for vibrated pavement concrete	57, 71	of mortar specimens containing blended		Drawbar dynamometer tests of trucks	233, 236-239
Concrete pavement slabs:		cements	154	Drilling jumbo, description and use	144, 146
length, relation to—		Curves, highway:		Drilling operations and equipment in tunnel	
behavior of joint filler materials	56	as affecting working capacities of highways	230	construction	132, 139, 142-147
effectiveness of thickened-edge design	54	curvature on ramps at grade separations	92	Drivers of motor vehicles:	
warping stresses	54	ice treatment at	15, 106	accident-prone drivers	33, 36
moving by compressed air	85	marking in interests of highway safety	36, 188	driving habits (passing practices, speed)	85,
Concrete pavements:		motor vehicle passing on—		187, 209-212, 221, 225-233, 240	
bituminous concrete pavements, <i>see</i> Bitumi-		as accident cause	78, 79	examination and licensing of	34-36, 80, 81
nous concrete roads		States prohibiting, number of	35	intoxicated drivers	34, 36, 78, 79
construction and design	53-57, 71, 101, 103, 108	practice	107, 209	reaction time	226
cracks in, causes and control	55-57, 112	transition curves—		training of	51, 78, 81, 82
grooving	101, 103	handbook, publication notice	241	Dual type pavements	83, 84, 93
ice treatment and effects of	106, 108, 153	recommendation	107	Ductility:	
light-reflecting properties, glare	101, 109-111, 121	tunnel construction on (Willamette tunnel)	125,	of asphalts extracted from pavements, rela-	
oil drippings on, relation to skidding	107	127-129, 131		tion to cracking	70, 71
patching with asphaltic concrete, Oregon		Cushion courses, bed courses, of brick pave-		requirements for distillation residues of—	
practice	108	ments	58-60, 72	emulsified asphalts	63
reinforced concrete pavements, construction	56, 57	Cut-back bituminous materials:		liquid asphaltic materials	62
report submitted to Road Congress	53-57, 71	cut-back asphalts, definition	61	Dummy type contraction joints, use in concrete	
skid resistance, nonskid treatment	101-108	use in construction of—		pavements	56
wet concrete pavements, friction coefficients		low-cost bituminous roads	61, 64-66, 70	Dust:	
of	101, 103-105	mastic beds of brick pavements	59	formation on road surfaces, control meas-	
Concrete portals for highway tunnels	128-130, 134-137	nonskid road surfaces	103, 104, 106-109	ures	62, 66, 105, 112, 118, 119
Congresses, Road, Permanent International As-		penetration macadam roads	64	ratios for sand-clay base course materials,	
sociation of, Eighth Congress of, at		stabilized soil bases and surfaces	67, 70, 115, 120	specification	173, 189, 190
The Hague, 1938:		Cuts:		removal from tunnel air samples in carbon	
agenda	53	load diagrams for	194, 195	monoxide analysis	147, 148
reports submitted to—		open cuts or highway tunnels, choice of	125	stone dust, use with slow-breaking asphaltic	
accidents on the road	77-82	stresses in, shearing	195	emulsions in dense-graded mix-	
brick pavements	58-60, 72			tures	62
cement in road surfaces	53-57, 71, 72			Dynamometers:	
light, reflection or absorption by road				drawbar dynamometer, field dynamometer,	
surfaces	101, 109-111, 121			for grade tests of trucks	233, 236-239
slipperiness of road surfaces	101-109			integrating dynamometer for measuring force	
subsoils, road, study of	112-120			exerted by skidding vehicle	102
tar, asphalt, and emulsions; use	61-71				
traffic on the highway, segregation of					
classes of	83-93				
Consistency tests, <i>see</i> Float test requirements—					
Viscosity(ies) of bituminous ma-					
terials (requirements for)					
Contraction joints in concrete pavements, re-					
quirements	56				
Controllers, types used in lighting and ventilat-					
ing systems in tunnels	137, 138, 148, 149				
Cotton fabric, use as reinforcement in bitumi-					
nous surfaces	70				
Cotton mattresses, cotton mats, use in curing					
concrete	71				
Coulomb method of determining earth pres-					
sures	193, 198, 199, 201				
Counties:					
areas of, as basis of allocation of State road					
funds	1, 6-8				
as highway administrative agencies	1-8, 12				
expenditures for snow removal	10				
safety organizations in	80, 81				
Counting machines, automatic traffic recorders	37-51,				
210-221, 225					
County roads:					
administration and financing of	1-8				
and local roads, funds for, from State tax					
receipts, 1937	167-170				
expenditures for and travel on (four States)	18,				
19, 21, 24, 26					
Cover materials, types and sizes used in construc-					
tion of—					
low-cost bituminous roads	64-66,				
103, 104, 106-108, 175					
macadam roads	105, 109				
nonskid surfaces	103-109				
stabilized soil roads and bases	118, 119, 175				
Crack fillers, tar for use in, application tempera-					
tures of	63				
Cracking processes in manufacture of asphaltic					
materials as affecting heterogeneity					
of materials	69				
Cracks:					
in bituminous surfaces	69-71, 103, 175, 176, 178, 180				
in brick (paving), broken brick limitation in					
specifications	58				
in cement stabilized soil bases after action of					
roller	119				
in concrete base courses of brick pavements	60				
in concrete pavements, causes and control	55-57,				
112					
in rigid pavements as caused by properties of					
subsoils	112, 120				
in tunnel roofs, preventive treatment	132				
in tunneled cliffs, relation to tunnel lining					
and ventilation requirements	125,				
131, 132					
Craig, R. E., author and joint author, a	37-51,				
213-221					

	Page		Page		Page
Intersections, highway—Continued.		Lime:		Maloney, J. E.	121
turning movements of traffic at	90-93	hard-burned free lime in cement as cause of		Marking:	
widening of approaches to	86, 89-91, 93	"delayed unsoundness" of concrete	55	of guardrails	12
Intoxication as cause of motor vehicle accidents	78, 79	use as separating agent for brick pavements		of highways—	
Iowa Engineering Experiment Station, research (slipperiness of road surfaces)	102	before application of filler	59, 105	at intersections	89, 91-93
Islands, traffic	85, 88, 89, 91-93	Liner plates, linings, for highway tunnels	125-137, 139-143	at pedestrian crossings	88, 89, 91
J		Liquid asphaltic materials, road oils:		on curves, recommendation	36
Jaster, John Jr., joint author, a	58-60, 72	consumption	61, 65, 66, 69, 70	reflector buttons, installation and costs	187-189
Johnson, W. W.	120	medium-curing materials	61-67, 70, 107	standardization as highway safety measure	79-81
Joint fillers:		rapidcuring materials	61-67, 70, 106-108	traffic lane marking	85, 93
for brick pavements	59, 60, 72, 104, 105	research (laboratory, field)	69, 70	Masonry portals of highway tunnels	128, 129, 134-136
for concrete pavements	56	slow-curing materials	61, 62, 66, 67, 70, 106, 107, 120	Massachusetts roads, nonskid construction	107
Joints:		specifications	61-63	Mastic beds (bituminous) for brick pavements	59, 60, 72
in brick pavements—		use in—		Mayo, G. W.	139 (fn)
bleeding	59, 60, 72, 104, 105	low-cost bituminous road construction	61-70	Mechanical analyses, <i>see</i> Grading.	
spacing, in monolithic pavements	60	mastic beds for brick pavements	59	Median strips, medial zones, for separation of traffic lanes, divided highways	36, 55, 83-85, 91-93, 188, 229-231
steel reinforcement	60, 72	nonskid treatment of roads	102, 106-108	Melting points of bituminous materials as affecting skid resistance of pavements	104, 106
in concrete bases of brick pavements	60	stabilization of soil bases and surfaces	105, 115, 120	Merritt Parkway (Connecticut)	87
in concrete pavements	56			Metal plates, angles, etc., use in joints of concrete pavements	56
in linings of tunnels	126, 127, 143, 144			<i>see also</i> Steel.	
Jurgenson, Leo	206			Michigan financial survey data (travel)	24, 25
K				Michigan highways, reflector buttons, installation	187-189
Kellermann, W. F., joint author, a	153-166			Mileages:	
Kelley, E. F., a	61-71			street and highway mileages—	
Keystone:				as basis of allocation of State road funds	1, 6-8
requirements for open-graded road-mix bituminous surfaces	65, 66			primary highway mileages, relation to all rural highway mileages and population per mile of primary highways (four States)	19
use in bituminous macadam roads	64, 107, 109			relation to population, motor-vehicle registration, and travel on highways (four States)	18, 24
Krey, H.	204			roads cleared of snow, 1936-37	9, 10
L				State-controlled roads, United States	3, 6-8
Land, benefits to through highway improvements as basis of taxation for highway purposes	6, 7			State highways in—	
Lanes, traffic:				Massachusetts	89
at intersections	91-93			United States, by number of lanes	83
in tunnels (highway), number	129, 131			total road and street mileages, distribution (four States)	26
marking of	85, 93			<i>see also</i> Federal-aid roads—United States Works Program projects.	
multiple-lane roads—				vehicle mileages, <i>see</i> Vehicle miles.	
lanes used by traffic on rural roads and in urban areas	85, 86			Minnesota financial survey data	17-30
relation to traffic capacity and safety	36, 83-87, 90, 93, 209, 230, 231, 233, 240			Miscibility tests of emulsified asphalts, requirements	63
of concrete pavements, construction as independent slabs with both edges thickened	56			Mississippi method of nonskid treatment of roads	107, 108
segregation of classes of traffic on	83, 85, 87			Missouri method of soil stabilization	120
separation by median strips, divided highways	36, 83-85, 91-93, 229-231			Mixed-in-place construction, road-mix construction:	
widths	55, 85			of bituminous surfaces	61-68, 105-109
Legislation:				of stabilized soil bases	67, 116-120
concerning—				Mixing methods and equipment used:	
administration of highways, centralization of	4, 5, 7			for pneumatically applied mortar linings of tunnels	140
freeways, construction of	87, 93			for sand-clay base course mixtures tested on circular track	174, 175
safety (highway)	33-36, 51, 77-82			in bituminous road construction	61-70, 105-109
State motor-vehicle funds, use for local roads and streets	7, 8			in preparation of soil-emulsion samples	115
motor-vehicle tax distribution laws	1			in stabilization of soils	67, 116-120, 174, 175
Length changes in mortar beams:				Mixing tests of emulsified asphalts for soil stabilization	64
comparator for measurement of	154			Mixing time, effects on hardening and ductility of asphaltic paving mixtures	70, 71
data for beams containing blended cements	157-159			Mohr method of determining earth pressures	193, 198-203
License and permit fees, registration fees (motor vehicle), receipts from, 1937	96, 97			Moistening of road-mixed materials used in soil stabilization, methods and equipment	67, 117-119
Licenses and permits:				Moisture:	
dealers' and distributors' licenses (motor fuel), receipts, 1937	73			effects on automatic traffic recorders, prevention	41
dealers' licenses and plates (motor vehicle), receipts from, 1937	96, 97			<i>see also</i> Absorption tests—Absorptive properties—Water.	
dealers' licenses, inspection fees, etc. (motor fuel), receipts, 1937, disposition of	167, 170			Moisture content of soils:	
distributors' and dealers' licenses in connection with motor-fuel tax, receipts from, 1937	73			computation, formulas for use in density tests of soils	114
drivers' licenses (motor vehicle)—				constant moisture content and incompressibility of soils	198
issuance and revocation	34-36, 80, 81			optimum moisture content, compaction to maximum density at	53, 114, 115, 118-120, 174, 175, 181, 182, 186
Uniform Vehicle Code	80, 81			relation to stability of road surfaces and bases	112-116, 173-186, 189, 190
Light:				Moisture-density curves in soil density tests	114
effects on bituminous materials	69, 70			Moisture equivalents of soils:	
photoelectric equipment for counting traffic	37-51			data for soils in experimental road	119
reflection or absorption by road surfaces under artificial lighting	53, 101, 109-111, 121			tests, <i>r.</i> to <i>p.</i>	112
stray light, effects on traffic recorders, reduction	41, 43			Molding:	
Lighting:				of density test soil samples, molds used	114, 115
of highways—				of stability test specimens of bituminous surface treated sand-clay mixtures, pressures used	174, 185
at traffic circles	92			Mortar:	
by floodlights	187			pneumatically applied mortar in tunnel construction	125-129, 132-134, 140, 147
by reflector buttons	187-189			properties as affected by blended cement	153-160, 165
equipment used in study of pavement glare	110, 111			Motor-carrier tax receipts (State), 1937, disposition of	169
pedestrian traffic lights	88, 91				
reflection or absorption of artificial lighting, pavement	53, 101, 109-111, 121				
of motor vehicles, headlights and glare from, pavement glare	78, 84, 101, 109-111, 121, 187-189				
of tunnels (highway)—					
lighting systems and their costs	125-127, 129-131, 135-140, 148-150				
transition lighting	125, 135-139				
Lights, traffic, <i>see</i> Traffic signs and signals.					

	Page		Page		Page
Motor-fuel consumption:		N		Photoelectric traffic recorders.	37-51, 219, 220
increase—		Nadai, A.	206	Photographic recording of traffic counts, exper-	
Massachusetts data.	90	Naphtha, use in preparation of cut-back asphalts.	61,	ments.	219
per registered motor vehicle, 1925-1936.	36		106, 108	Piers (bridge), principles of soil mechanics in-	
statistics, by States (1937).	74, 75	National Conference on Street and Highway		volved in construction of.	193-207
usage of motor fuel, analysis of.	74, 75	Safety, legislation advocated by.	34, 80	Pipes (vertical) in concrete linings of tunnels.	141
Motor-fuel taxes, State:		National Research Council, <i>see</i> Highway Re-		Pitches and pitch mastics as joint fillers in brick	
amounts and bases of, State laws governing.	1, 2, 7	search Board.		pavements.	59, 60
exemptions (gallons of motor fuel), 1937.	74, 75	National Safety Council, activities.	35,	Plane strain, problems of.	193-207
rates, 1937.	73-75		51 (fn), 77, 79, 81	Planes of weakness, weakened-plane joints:	
receipts from—		National Traffic Safety Contest.	79, 80	in concrete base courses of brick pavements.	60
amounts, statistics by States, 1937.	73, 167	Negro farm families, automobiles owned by.	13, 14	in concrete pavements.	56
disposition of—		New Hampshire financial survey data (travel).	24, 25	Planing machine.	109
for highway purposes.	1-3,	New Mexico financial survey data (travel).	24, 25	Planning of highways, traffic studies pertaining	
to State highways and local roads	167	New York City:		to.	3-7, 17-30, 33-51,
and streets, 1927-1936.	8	residents of, taxes paid by, motor vehicles		77-93, 187-189, 209-221, 225-240	
refunds, 1937—		owned by highway use by.	17,	Plant-mixed bituminous roads:	
gallons of motor-fuel subject to re-		streets of—	18, 20, 21, 24, 25, 28, 29	equipment used in construction of.	67-69
fund.	74	expenditures for (1932).	19, 27	materials and construction methods.	61-70, 108
refunds paid.	73, 75	mileage of.	18, 26	<i>see also</i> Premixed bituminous surfaces.	
receipts other than tax receipts in connection		travel on.	18, 24, 25	Plant mixing of soils in stabilization of roads and	
with (1937).	73	New York (State), financial survey data.	17-30	bases.	116-118, 120
Motor-vehicle taxes, State:		Newmark, Nathan M., r. to p.	204, 205	Plantings:	
legislation.	1, 2, 6-8	Night driving of motor vehicles:		in separating strips of divided highways.	84, 88
receipts from—		accident data.	78, 187	roadside plantings for snowdrift control.	10, 11
amounts, statistics by States, 1937.	96, 97, 168	<i>see also</i> Glare.		Plastic bending of metals.	206, 207
disposition of, statistics by States, 1937.	168	Nonskid finishes for traffic plates.	105	Plastic equilibrium method, use in computing	
use for highway purposes, allocations for		Nonskid paving bricks, future development of.	58	bearing capacity of soil under	
highway purposes.	1-3,	Nonskid treatment of roads.	101-109	bridge abutment.	194, 203, 204, 206, 207
for nonhighway purposes, allocations	5-8, 19, 20, 22, 167-170	Normann, O. K., a.	225-232, 240	Plastic flow:	
for nonhighway purposes.	2, 6, 167-170	North Carolina roads, surface treatment of, r. to	173 (fn)	as cause of failure of soils under bridge	
<i>see also</i> Motor-carrier tax receipts (State)—		Nuss, A. B.	121	abutments.	199
Motor-fuel taxes, State—User re-				resistance to, by soil-emulsion mixtures,	
venues, highway.		O		measurement by stability tests of	
Motor vehicles:		O'Connell, T. S.	121	mixtures.	115
classes of, segregation on highways.	83-93	Ohio experiments, brick roads and joint fillers		Plastic limits of soils.	115, 118
commercial motor vehicles—		for.	58-60, 72	Plasticity index(es):	
safe operation of, promotion of.	80	Oil, linseed, as protection against action of chlo-		of fine aggregates used in dense-graded low-	
slow-moving vehicles, effects on traffic		rides in ice treatment of roads.	13	cost bituminous surfaces, require-	
capacities of highways.	210, 232, 233	Oil-stained concrete pavements:		ments.	66
cost data for used and new cars purchased		light reflecting properties, glare.	109-111	of soils—	
by farm families.	13, 14	oil drippings as affecting sideways skidding of		data for various road and base soils.	116, 119,
dimensions—		motor vehicles.	107	173, 174, 177, 181-183, 185, 186, 189	
State regulations, nonuniformity of.	35	Oil treated roads, friction coefficients.	102, 104, 105	limiting value—	
studies of.	209, 213	Oils, road, <i>see</i> Liquid asphaltic materials—Oil		for base course material.	112, 114, 189, 190
headlights—		treated roads.		for embankment material.	116
glare from.	78, 84, 101, 109-111, 121, 187, 189	Oltens spot tests.	69, 70	variation in roads stabilized with	
illumination of reflector buttons.	188, 189	Open-graded, open-mix, bituminous surfaces.	62-66,	graded soil mixtures.	116
inspection.	33-36	70, 104, 107-109		Plasticity of soils:	
mechanically defective motor vehicles,		Operating costs of motor vehicles, <i>see</i> under		as affected by—	
operation—		Motor vehicles.		dissolved salt in stabilized soil mix-	
as cause of highway accidents.	78	Oregon roads:		tures.	118
prevention of.	36	construction and maintenance methods.	104,	excess bitumen content of stabilized	
number—		108, 109		soils.	120
in United States—		ice treatment, sand spreader for use in.	13	as affecting compaction—stability relations	
increase.	36, 83, 94	Overheating of bituminous materials during		of bituminous surface treated	
registrations, statistics, 1937.	94, 95	refining process, effect upon het-		sand-clay bases.	178-183, 187, 189, 190
per mile of road (four States).	18, 24-26	erogeneity of materials.	69	test methods, r. to p.	112 (fn)
operating costs—		Overpasses, overhead bridges.	87, 89	Pneumatic pressure, use in applying mortar in	
estimated transportation costs for one				tunnel construction.	125-129,
year (four States).	17	P		132-134, 140, 147	
reduction through improvement of		Paddock, Robert H., a.	17-30	Poisson's ratio as applied to soil maintained at	
highways.	2, 6, 15, 105	Page toughness tests of aggregates.	64	constant moisture content.	198
ownership—		Palmer, L. A., a.	193-207	Police:	
by farm families.	13-14	Park and forest roads, etc.		funds for State highway police, from State	
in rural areas, in urban areas (four		funds for, from State tax receipts, 1937.	167-170	tax receipts, 1937.	167-170
States).	17, 20, 21, 23-25, 28-30	tunnels on.	125-150	training in interests of highway safety.	35, 51, 79, 82
publicly owned vehicles, registrations,		Parking of motor vehicles, parking spaces.	53,	Polished road surfaces, glazed road surfaces,	
1937.	94, 95	85, 86, 90, 93, 189		skidding characteristics.	103, 104, 106
passenger motor vehicles—		Parkways.	55, 83, 87, 91, 93	Population:	
registrations and fees paid for, United		Passing of vehicles on highways.	35, 83-85,	as basis for allocation of State road funds.	1, 6-8
States, 1937.	94-97	187, 209-213, 221, 227, 232, 233, 240		distribution of, relation to—	
use of highways, travel on highways.	2,	Patching:		motor-vehicle registrations and street	
17-30, 187-189, 209-212, 221, 225-240		of pavements, Oregon method.	108	and highway mileages (four	
35,		of stabilized soil surfaces, use of calcium chlo-		States).	18, 19, 29
83-85, 187, 209-213, 221, 233		ride admixture.	117, 118	taxation, highway expenditures, and	
persons per vehicle.	18, 28, 78	Patrols:		highway use (four States).	17-30
skidding and prevention of (ice treatment,		highway patrols.	34, 35, 80-82	Portal structures of highway tunnels.	125,
nonskid treatment, of roads).	9-13,	school patrols.	51, 80	128-139, 148, 150	
15, 53, 101-109, 153		Paving plants:		Powder requirements in construction of high-	
spacings (distance, time) on highways.	209,	bituminous paving plants.	65-68	way tunnels.	146
speeds.	78, 79, 83, 91,	concrete paving plants.	55, 71	Power consumption:	
93, 102-105, 187, 209-213, 217, 225-241		Paxon, G. S.	109, 121	comparative data for incandescent lamps	
stopping distances.	102, 209	Payne, E. B.	140 (fn)	and sodium vapor lamps in tunnel	
used vehicles and new vehicles, comparative		Pedestrians:		lighting.	137
purchases by farm families.	13, 14	in highway tunnels, sidewalks in tunnels.	125,	for lighting and ventilation of highway	
weights, studies of.	209, 213	129, 131, 133, 135, 137, 139		tunnel.	150
<i>see also</i> headings beginning Traffic—also Ac-		on highways—		Power requirements (electric) for automatic	
cidents, highway—Busses, motor—		accident data.	35, 78-82, 86-91, 93	traffic recorders, cost data.	48, 50
Legislation—Licenses and per-		control.	88, 89, 91	Power units, power-driven machines, used:	
mits—Trucks, motor.		safety islands for use of.	85, 88, 89, 91-93	in bituminous road construction.	67-69, 109
Motorcycles:		segregation of, footpaths and sidewalks		in concrete road construction.	53, 57, 71
registration fees, receipts from, 1937.	96	for.	53, 87-90, 93	in snow removal.	9-13
registrations, 1937.	94	visibility.	187, 189	in tunnel construction.	139, 142-147
Moyer, R. A.	102-105, 107, 121	Penetration tests of recovered asphalt, r. to p.	71	Prandtl's formula for supporting power of soils.	193,
Mucking operations and equipment in highway		Penetration type bituminous roads and mate-		196, 197, 204	
tunneling.	139, 142-147	rials for.	62-64, 69-71, 108, 109	Premixed bituminous surfaces:	
Muddy roads, skid resistance tests.	102, 104-106	Penetration(s) of bituminous materials:		materials and construction methods.	63,
Mulch roads (bituminous), friction coefficients.	104, 105	data for materials used—		nonskid bituminous surfaces.	104, 106, 107
Mullen, C. S.	121	as fillers in brick pavements.	59, 60, 72	Pressure(s):	
Multiple-lane highways:		in nonskid treatment of roads.	166-169	air pressures used in cement gun in tunnel	
divided highways.	36,	in stabilization of soils (emulsified as-		operations.	140
54, 55, 83-85, 90-93, 188, 229-231		phalts).	64	earth pressures in supporting soils—	
mileage data (State highways).	83	requirements for residues—		of retaining walls and bridge abutments.	
relation to traffic capacity and safety.	36,	of emulsified asphalts.	63	calculations.	193-207
83-87, 90, 93, 209, 230, 231, 233, 240		of liquid asphaltic materials.	62	of tunnels, consideration in tunnel	
segregation of classes of traffic, a.	83-93	Phelps, H. E.	121	operations.	132, 140
stage construction.	83, 85	Phillips, Roy L., joint author, a.	58-60, 72	used in molding specimens of bituminous	
		Photoelectric relay in lighting system of highway		treated soil mixtures in circular	
		tunnel.	137, 138	track tests.	185
				<i>see also</i> Loads.	

	Page		Page		Page
Primary roads (State):		Revenues, highway—Continued.		Sand—Continued.	
expenditures for and travel on (four States)	18, 19, 21-30	statistics (1937), by States, for—Continued.		use—	
mileage data (four States)	19, 26	State motor-fuel tax receipts	73, 167	as base course material for brick pavements	60, 72
priority in highway planning and finance	2, 5-7	State motor-vehicle receipts	96, 97, 168	as cover material in road construction	64-66, 119
Prime coats, materials used:		use for, allocations for, nonhighway purposes	2, 6, 167-170	as filler in brick pavements	72
in low-cost bituminous roads	62, 63, 55, 175	see also Federal-aid roads—United States Works Program projects.		as subgrade material	112-114, 116
in sand-clay base course mixtures tested on circular track	175	Reymer, S. E., joint author, a	213-221	in absorption tests of soil-emulsion mixtures	115
Proctor method of compaction of soils at optimum moisture content	53, 114, 120, 174, 175, 181, 186	Right-of-way rules, failure to observe as cause of highway accidents	78, 79, 81	in nonskid treatment of roads	103, 106
Profilometer, recording	176	Right-of-ways:		in seal coats of asphaltic concrete pavements	108
Property:		lines in relation to transition curves, r. to p.	241	in stabilization of soils	67, 112-116, 173-175, 189, 190
abutting properties on bypass roads, access from, control by State	86, 87, 13	r.	84, 87, 88, 91, 92	on icy roads	10, 12, 13, 15, 105, 106, 108
assessed valuations of, as bases for distribution of State road funds	6, 7	Roach, T. M.	141 (fn), 143 (fn)	Sand aggregates:	
Property damage in motor-vehicle accidents, reporting of	77	Road Congresses, see Congresses, Road.		in concretes and mortars containing blended cements and effects of	153, 154, 157-159
Property taxes as source of road funds	1, 3, 6, 7, 19, 20, 22, 29	Road consolidation programs	1-8	in densely graded asphaltic mixtures, emulsions for use with	62
Proportioning of materials:		Road-mix construction:		Sand-clay bases:	
in bituminous surfacings—		of bituminous surfaces	61-68, 105-109	bituminous surface treatment	65, 173-186, 189, 190
control by traveling mixing plant	66	of stabilized soil bases	67, 116-120	materials for—	
nonskid surfacings	104, 106, 108	Road oils see Liquid asphaltic materials—Oil treated roads.		a.	173-186, 189, 190
in concrete, proportions used—		Road-use survey data, see Use of highways.		specifications, proposed	113, 189
for concrete bases of brick pavements	72	Roadside developments as traffic hazards	187	Sand-clay-gravel bases, bituminous surface treatment	65
for vibrated pavement concrete	57	Rock backfills in highway tunnels	126, 127, 131, 134, 143	Sand cushions:	
in specimens containing blended cements	153, 164	Roettger, E. L.	121	as backfills in highway tunnels	126, 127, 131, 134, 141, 143
in winter in northern United States, in the South	56	Rollers, rolling operations:		as bed courses of brick pavements	59, 72
practice, present	56	improvements in rollers	68, 69	Sand spreader for ice treatment of roads	13
in lime whitewash for use on brick pavements	105	in construction of—		Sandpaper type of road surfacing, slight road roughness, as affecting:	
in mortar test specimens containing blended cements	154	bituminous roads	64-69, 106-109	light-reflecting properties of surfacing	101, 109-111, 121
in stabilization of soil roads and bases	67, 113-116, 173, 174	brick pavements	59	skid resistance of surfacing	101-109
Pugmill mixers, use in soil stabilization	116, 125	cement-bound macadam roads, effect of heavy rollers	71	Sandstone rock asphalt road surfaces, friction coefficients for	104, 105
Pulaski highway (New Jersey), traffic on	87	stabilized soil surfaces and bases	67, 116-120	Sandy filler in gravel surfaces, relation to effectiveness of calcium chloride treatment of surfaces	118
Purcell, C. H.	77, 82	pneumatic-tired rollers	67, 117	Sandy surfaces, skid resistance of	103, 105, 106
		sheepsfoot rollers	53, 67-69	Sawdust, use as joint filler in concrete pavements	56
		Rolling resistance, determination in grade tests of trucks	235-239	Sealing:	
		Ros, W. C.	121	of bituminous surfaces tested on circular track	176, 178
		Rotary traffic, rotary intersections of highways	91, 92	of concrete surfaces as caused by action of salts	106, 153, 161
		Rotating moments produced by earth pressures		Scarifying methods and equipment used in soil stabilization	117-120
		feeling stress distribution in undersides of retaining walls and abutments	197, 198	Schlesinger, G. F. (George F.):	
		Roughness, pavement:		acknowledgment	121
		relation to—		joint author, a	58-60, 72
		light reflection, glare	101, 109-111, 121	School patrols in interests of highway safety	51, 80
		skid resistance of pavement	101-109	Schools:	
		see also Smoothness, pavement.		safety instruction in, highway	80-82
		Rubber fillers for joints	56	training schools for traffic officers	79, 82
		Rubber tubing for use with traffic recorders, air switches	50, 211-220	Screeds of finishing machines used in bituminous road construction, description	69
		Rules of the road:		Screenings, use:	
		failure to observe as cause of highway accidents	78, 79	in bituminous mats for stabilization of road surfaces	105
		legislation concerning, in highway safety program	81	in nonskid treatment of bituminous surfaces	106-109
		nonuniformity of	35	Screens, rotary, use in plant mixing of graded soil mixtures	117
		Runner, D. G., joint author, a	153-166	Seal coats of bituminous pavements	63-66, 103, 104, 106-109
		Rupture:		Seal stone, size requirements for low-cost bituminous roads	65, 66
		moduli of, test data for—		Secondary roads:	
		bituminous paving mixtures, r.	70	Federal aid for development of—	
		concretes containing blended cements	160, 161	centralized administration of secondary roads	5-7
		rupture planes in earth masses against retaining walls	200	Federal-aid projects, current statistics	37
		Rural areas, residents of, contributions to highway travel and expenditures	17-30	99, 123, 152, 172, 192, 235, 243; rear covers of Nos. 4, 10, 26	
		Rural roads:		see also Local roads and streets.	
		accidents (motor vehicle) on, investigation and reporting of	35	Sedimentation tests of emulsified asphalts	62, 63
		administration and financing of	1-8, 17-30	Seismographic profiles of rock formations, usefulness in tunneling operations	125
		see also Federal-aid roads—Motor-vehicle taxes, State—United States Works Program projects.		Separating agents used on brick pavements	59, 105
		mileage data for four States (percentages)	26	Service behavior of bituminous roads:	
		snow removal and ice treatment	9-13, 15, 105, 106, 108	circular track test data	173-186, 189, 190
		travel on, data for four States	17-30	correlation with test results, research	69-71
				Service roads	90, 92
				Settlement:	
				of soils beneath bridge abutments, plane strain problems	193-207
				of soils beneath pavements	53, 108
				Settlement tests of emulsified asphalts	62, 63
				Shale:	
				types unsuitable for use in soil stabilization	113
				see also Tunnel construction, highway.	
				Sharecroppers, automobiles owned by	13, 14
				Shearing strength of bituminous paving mixtures, tests, r.	70
				Shearing stresses in undersides of retaining walls and bridge abutments, plane strain problems	193-207
				Sheepsfoot rollers	53, 67-69
				Sheets, Frank T.	54
				Shoulders, highway	36, 83, 85, 87, 89, 106, 187
				Shrinkage:	
				of mortars containing blended cements	157, 158, 165
				of soils, shrinkage limits, shrinkage tests	119, 115, 119
				see also Compaction—Volume change(s).	

- Sidewalks:**
in cuts and fills, designs (Massachusetts) 80
in highway tunnels 125, 129, 131, 133
relation to pedestrian accidents 87-90, 93
Sieve analyses, *see* Grading—Sieve tests.
Sieve tests of emulsified asphalts, requirements 63
Sight distances on highways 36, 83, 91-93, 209, 233, 240
Signs and signals, traffic 12
34-36, 78-81, 87-89, 91-93, 148, 150
Silica as component of sand-clay materials tested on circular track 173, 174
Silt and silty soils 67, 112, 116, 119, 186, 189
Six-lane highways:
mileage data, United States 83
traffic on, behavior of 84-86
Skidding, motor vehicle:
nonskid paving brick, future development of 58
nonskid treatment of roads 101-109
prevention of, driving practices aiding 12, 13
relation to pavement type and condition 53, 101-109
Slag:
abrasion test applicable to 64
specification for crushed slag used in open-graded bituminous road-mix surface courses 66
use—
as cover material in nonskid treatment of roads 106
in stabilization of soils 113
Slipperiness, road 12, 13, 53, 72, 101-109
Slopes, treatment of 15, 36
Slump:
of concrete tested for effects of blended cements 159, 164
of vibrated pavement concrete 57, 71
Smith, J. G. 121
Smoothness, pavement:
bituminous pavement smoothness, machines producing 69, 109
concrete pavement smoothness as produced by delayed finishing 108
see also Roughness, pavement.
Snow-covered roads, skid resistance of 102, 103, 105, 106
Snow fences, mileages and costs 9-11
Snow removal:
and ice treatment on rural highways, a 9-13
cost data 9, 10, 125
equipment 9-13, 15
mileages of roads cleared of snow, 1936-37 10
Snowdrift control on highways 9-11
Snowfall figures for various States, two seasons 9, 10
Snowsheds 10-12, 135
Sodium chloride, *see* Salt (s), use.
Sodium luminaires, use in highway tunnels 126, 136-139
Sodium sulphate soundness tests of mortars containing blended cements 154, 158, 159, 165
Softening points of bituminous materials:
as affecting behavior of asphaltic joint fillers in brick pavements 59, 60
requirements for residues of tars 63
Soil-cement mixtures:
cement-hardened earth roads, experiments 72
use in stabilization of soils 113-115, 118, 120
Soil-emulsion mixtures, use in stabilization of soils 62, 64, 67, 70, 115, 119, 120
Soil groups, subgrade 112, 116
Soil mechanics, principles involved in design of retaining walls and bridge abutments 193-207
Soil mixtures, graded 67, 112-120, 173-186, 189, 190
Soil roads, *see* Earth roads.
Soil sampling 112, 114, 115
Soil surveys:
methods, r. to p. 112 (fn)
usefulness of 112, 120
Soil-tar mixtures, use in stabilization of soils 67, 70, 113, 115, 119, 120
Soil tests 53, 112-115, 120, 174, 175, 181, 182, 186, 189
Soils:
specifications, proposed, for materials for surface courses and base courses 113, 114, 189
study of road subsoils, a 112-120
supporting power *see* Supporting power.
weights—
determination in soil tests 114, 115
ratings of embankment soils by dry weights 116
relation to supporting power 193, 196, 197, 200-204
see also names of types of soils and names of properties of soils.
Solubility in carbon disulphide, requirements for residues of:
emulsified asphalts 63
liquid asphaltic materials 62
Solvents, types used:
for cutting back excess asphalt on bituminous surfaces 106
in manufacture of cut-back asphalts 61
Soundness tests of mortars containing blended cements 154, 158, 159, 165
South Carolina experiments, stabilized soil bases 118, 119
Southern States, low-cost roads in, sand-clay materials for use in 173-186, 189, 190
Specific gravity:
apparent specific gravity, data for cements used in test concretes containing blended cements 154
bulk specific gravity, data for mortars containing blended cements 154, 158, 159, 165
of soils in experimental soil road 119
requirements for—
distillation residues of emulsified asphalts 63
tars 63
Specific surface, test data for cements used in concretes containing blended cements 154
Specific viscosity of bituminous materials:
as basis of consistency requirements 62
see also Viscosity(ies) of bituminous materials.
Speed, motor vehicle:
in tunnels, normal speeds, provision for 125, 135-137
on highways—
measurement of, time-recorders for 210-212, 225, 234
relation to—
safety 36, 79, 93, 101-105
skidding 101-105
traffic capacities of highways and highway design 55, 83-85, 91, 209, 221, 225-232, 240
traffic study data 209-212, 225-232, 240
Spot tests of bituminous materials 69, 70
Spray-bar (new) for bituminous distributors 67, 68
Sprays:
for brick pavements before application of joint fillers 59, 105
water-soap solution for use in construction of penetration macadam roads 109
Spreaders, spreading operations:
in bituminous road construction 65-69
in stabilization of soil surfaces and bases 67, 117-120
in ice treatment of roads 13, 15, 105, 106
Sprinklers, sprinkling operations, in stabilization of soils 117, 118
Stability:
of bituminous paving mixtures, comparison of hot-laid and cold-laid dense-graded mixtures 64
of bituminous treated soil surfaces and bases—
as affected by—
consolidation, density, moisture content 173-186, 189, 190
excess bitumen 120
circular track test, data for surface treated sand-clay bases 173-186, 189, 190
Missouri investigations 120
of soils—
data for soils in subgrade soil groups 112
principles of soil mechanics involved in design of retaining walls and bridge abutments, a 193-207
see also Stabilization (of soil roads and bases)—Supporting power (of soils).
Stability tests:
of bituminous surface treated sand-clay mixtures 181-185, 190
use in determining amount of bituminous emulsion to use in soil stabilization 115
Stabilization:
of gravel surfaces 105
of macadam surfaces 105
of slopes above portal structures of highway tunnel 135
of soil roads and bases—
materials, methods, and equipment 62, 64, 67-70, 105, 112-120, 174, 175
specifications (proposed) for materials for 113, 114, 189
Stage development of highways 83, 85, 92
State-aid roads, financing of 1-8
State and Federal safety organizations 33-36, 51, 79-82
State, county, and municipally owned motor vehicles; registrations, 1937 94, 95
State highway departments:
administration of local roads 2-7
supervision of snow removal 12
State roads:
financing of, funds for 1-8, 17-30, 167-170
see also Federal-aid roads—United States Works Program projects.
travel on rural highways, survey data (four States) 17-30
State taxes *see* Motor-carrier tax receipts (State)—Motor-fuel taxes, State—Motor-vehicle taxes, State—Property taxes—Taxation for highway purposes—Tax revenues, highway.
Steel:
drill steel, type used in tunnel construction 146
reinforcing steel, *see* Brick pavements (reinforced brick pavements)—Concrete (reinforced concrete).
structural steel, steel plate linings, use in highway tunnels 125-129, 131-133, 135, 141-145
Steel load-transmission devices for use in concrete pavements 56
Steel strips, use in traffic detectors 218-220
Steel traffic plates, skid resistance of:
design for increasing 105
tests of 102-105
Steel-troweled concrete surfaces, skid resistance of 103
Stone, *see* Aggregates—Cover materials—Rock backfills.
Stopper drills, use in highway tunneling 142
Strain, plane strain problems in design of retaining walls and bridge abutments 193-207
Streets, city and village:
financing of, funds for 1-8, 17-30, 167-170
mileage data (four States) 18, 26
traffic islands on 85, 88, 89, 91-93
traffic on—
survey data (four States) 17-30
through traffic, segregation of 90
variations—
by days of the week 49
by hours of the day 48
Strength tests:
of cement-bound macadam, slab strength as affected by compaction method 71
see also Compressive strength—Flexural strength—Tensile strength.
Stresses:
in concrete pavements 54, 56, 57
in undersoils of retaining walls and bridge abutments 193-207
see also Compressive stresses.
Struts used in tunneling operations 131, 133, 141
Sub-base of circular track and effect of condition on sand-clay base course materials 173, 175, 177, 178, 180, 181
Subgrade surveys, usefulness of 112, 120
Subgrades:
of concrete pavements, progress in construction of 53, 54
of road surfaces in highway tunnels, drainage 133
of sidewalks in highway tunnels, as location for tunnel drainage and wiring facilities 133
soils for use in 112-120
see also Soils.
Subsoils, use 67, 120
Subsoils, road:
conditions of, as affecting requirements for base courses of brick pavements 60
properties of, influence on road construction and maintenance 53, 112-120
see also Soils.
Succrate liquor, use as admixture in stabilization of soils 113
Sulfite liquor, use as admixture in stabilization of soils 113
Sulphurs (plasticized), use as joint fillers in brick pavements 59, 60
Sunday driving of motor vehicles, accident data 79
Superelevation of highways 209
Supporting power:
of rock formations, consideration in design of highway tunnels 139, 141, 142
of soils—
as factor in design of—
concrete pavements 54
retaining walls and bridge abutments, calculations 193-207
data for soils in soil groups 112, 113, 116
Surface-removal method of bituminous filler application to brick pavements 59, 60, 105
Surface treatment, bituminous, *see* Bituminous surface treatment of roads.
Surfacing, road:
as influenced by properties of subsoils 53, 112-120
color and texture, differences in multiple-lane highways, advantages of 83, 84
dual type surfacing 83, 84, 93
type and condition, relation to—
glare 101, 109-111, 121
skidding, motor vehicle 101-109
see also names of types of pavements.
Surveys:
automobile purchases by farm families 13-14
financial survey data (four States) 17-30
soil surveys, subgrade surveys 112, 120
surface treatments on sand-clay, topsoil, and gravel bases in North Carolina, r. to p. 173
traffic surveys, *see* Traffic studies.
Switches:
road switches used with traffic detectors, traffic recorders 50, 211-220
switch controls of chemical analyzers used for tunnel air samples 147-149
T
Tabulating machine cards for use in highway capacity studies 225, 226
Tachometers 67, 238
Tale, use in traffic detector tubes 211
Tamping methods, tamping apparatus 54, 71, 114, 115, 141, 181, 185
see also Rollers, rolling operations.
Tank cars (railroad) for shipment of bituminous materials, heaters for, improvements in 67
Tank trucks, use in soil stabilization 118

	Page		Page		Page
Tar:		Three-lane highways:		Traffic volume:	
consumption in United States	61, 69	accident data	83, 85	as basis of distribution of State road funds	1, 2, 6, 7
definition	61	in programs of stage development	83	data for Wawona tunnel, Yosemite National Park	150
research, r. to p.	70	traffic capacities of	83, 93, 229-231	variations on roads carrying different classes of traffic	45, 48, 49
specifications	61-63	Through traffic, bypass roads for segregation of parkways	55, 83, 85-88, 90, 91, 93	see also Traffic capacities of highways—Traffic studies.	
use—		Tie bars, type used in longitudinal joints in concrete pavements	56	Trailers and semitrailers:	
as filler in brick pavements, special coal-tar pitch	59, 60	Timbering operations in highway tunnel construction, timber linings of tunnels	125-129, 131-134, 139-143, 147	registrations and fees paid for (United States), 1937	94-96
as prime coat on sand-clay base course test mixtures	175, 182	Time-control mechanisms in traffic counters, modification of	220	rollers, multiple-wheel	69
in bed courses of brick pavements	59, 60	Time-recording apparatus used in traffic studies	37-51, 210-221, 225, 226, 234, 236	sand spreader	13
in bituminous road construction	53, 61-66, 69, 70, 101-105, 108, 175, 182	Time spacing of motor vehicles on highways	212, 225-232, 240	two-wheel unit used in skidding tests of road surfaces	102
in nonskid treatment of roads	101-105, 108	Time-speed curves in grade tests of motor trucks	236	Training:	
instabilization—		Time-temperature relations in freezing and thawing tests of concrete containing blended cements	160	of drivers of motor vehicles	51, 78, 81, 82
of gravel surfaces and macadam surfaces	105	Tires, motor-vehicle:		of traffic officers, training schools	79-82
of soils	67, 70, 113, 115, 119, 120	friction between tires and road surfaces	59, 101-105, 236	Transition curves (highway), handbook, publication notice	241
viscosity requirements, specifying in terms of absolute units	62	skid resistance of new and worn tires on various types of road surfaces	101-105	Transport surveys, State	36
Tar surface treated roads:		tractive effort produced at surfaces of, data from grade tests of trucks	235-239	see also Traffic studies.	
friction coefficients of	104, 105	types used on equipment for—		Transportation, see headings beginning Hauling, Traffic, Transport.	
r. to p.	173 (fn)	bituminous road construction	67-69	Transverse cracks in concrete pavements, formation, relation to slab length	56
Taxation for highway purposes:		circular track tests of road materials	173, 175	Transverse joints:	
bases of, discussion of	17-30	soil stabilization	117	in brick pavements (monolithic)	60
financing of local roads and streets, a.	1-8	Toms, R. E., a	83-93	in concrete base courses of brick pavements	60
rural and urban contributions to highway travel and expenditures, a.	17-30	Topsoil, suitability for use in soil roads and base courses	113, 173	in concrete pavements—	
tax distribution laws (State)	1, 7, 8	Torque, engine torque and power curves in computation of hill-climbing ability of trucks	233, 235, 236, 239	doweled transverse joints, effectiveness	56, 57
see also Motor-fuel taxes, State—Motor-vehicle taxes, State—Property taxes.		Toughness:		practice, present	56
Telegraph keys, use:		of aggregates, tests	64	Travel (motor vehicle) on highways:	
with chronographs	234	of bituminous paving mixtures, tests	70	contributions to, rural and urban	17-30
with traffic counters	211	of brick (paving), criterion of	58	see also Use of highways.	
Telephone equipment, use:		Tourist traffic, traffic on roads serving recreational areas	2, 6, 45, 48, 49	Trees:	
in highway tunnel	150	Town roads and township roads:		protection during highway construction	207
with traffic counters	211, 217	administration and financing of	1-8, 19, 22, 26, 27	see also Plantings.	
Temperature control in tunnels during placing of pneumatically applied mortar linings	140	mileage data (three States)	26	Trowels, steel, use in finishing concrete pavements, relation to skid resistance of pavements	103
Temperature variations as affecting:		travel on (four States)	18, 22, 27	Trucks, motor:	
concrete base courses of brick pavements, lean concrete base courses	60	Township property taxes for highway purposes (three States)	20, 22	age as affecting performance	233
concrete during curing, prevention by use of cotton mattresses	71	Tractive effort of truck wheels, tractive resistance of vehicles, in grade tests of trucks	235-239	and busses—	
operation of traffic recorders	41-43, 216	Tractors, tractor-drawn equipment:		counting in traffic surveys, method and equipment	38, 39
Temperature warping of concrete pavements, relation to spacing of joints	56	testing, dynamometer used in	238	loading and unloading, provisions for on multiple-lane highways	85
Temperature(s):		use in—		use of highways	2, 21, 22, 38, 39, 211, 225
application temperatures, heating temperatures, of bituminous materials and bituminous mixtures		bituminous road construction	68, 109	and tractor trucks, etc., registrations and fees paid for (United States), 1937	94-97
effects on hardness and ductility, research	70, 71	snow removal	9-11, 15	regulation(s)	79, 233
practice	63, 106-109	stabilization of soils	117-119	segregation on highways	83, 87
curing temperatures used for mortar specimens and concrete specimens containing blended cements	154, 158, 159	see also Trucks, motor (and tractor trucks).		speeds—	
drying temperatures used—				in grade tests	234-239
for mortar specimens containing blended cements	154, 157			relation to traffic capacities of highways	210, 233.
for soil-emulsion mixtures	115			tests of—	
in soil tests	114, 115			dynamometer for use in	238
low temperatures—				hill-climbing ability	233-239
effects on bituminous materials, research	69-71			use in snow removal	9-13, 15
ice treatment methods during	105, 106			weights that can be pulled up given grades at given speeds, formula and tests	234-239
summer temperatures as affecting exudation of bituminous fillers in brick pavements	59, 72			Tubing, rubber, for traffic recorders, air switches	50, 211-220
testing temperatures used—				Tunnel construction, highway:	
for bituminous materials, requirements for—				cost data	125, 129, 131, 143, 145, 146, 150
emulsified asphalts	63			methods and equipment—	
liquid asphaltic materials	62			German method	125, 130
tars	63			used in Western States	125-150
for mortars and concretes containing blended cements	154, 157, 158, 160			rates of advance per day	142, 145-147
in "autoclave" tests of cements	55, 159, 165			Turbidimeter, r.	153
Tensile strength:				Turning movements of traffic, see Traffic (turning traffic).	
of bituminous paving mixtures, tests, r.	70			Two-lane highways:	
of cements used in test concretes containing blended cements	154			accident data	83, 85
of mortars containing blended cements	154, 158			mileage data (United States)	83
Tension:				traffic capacities of	83, 93, 226-233, 240
in material beneath fills, formula for vertical earth pressure	195			widths	84, 85, 93
surface tension in grooved pavements as affecting run-off of water	101, 111			U	
Terzaghi, Charles, r. to p.	198 (fn), 200 (fn), 201 (fn)			Underpasses	87, 89
Texas roads, nonskid treatment of	106			Uniform Vehicle Code, r.	80, 81
Texture of road surfaces as affecting:				United States Works Program projects, current statistics:	
glare	101, 109-111, 121			grade crossing projects	rear covers of Nos. 1-3
slipperiness	101-109			highway projects	rear covers of Nos. 1-3
Thaws, thawing, see Freezing and thawing tests—Ice-covered roads.				contributions to highway travel and expenditures	17-20
Thickened-edge design of concrete pavements:				see also Cities.	
effectiveness, relation to length of slab	54			Use of highways:	
"equivalent uniform thickness" of corners, determination	54			increase, 1925-1936	36
uses of	54, 56			relation to centers of population, highway taxation, and highway expenditures	1-8, 17-30
Thickened edges of concrete base courses of brick pavements	60			see also User revenues, highway.	
Thickened ends of concrete slabs at joints	56			User revenues, highway	1-8, 17-30, 170
Thickness:				see also Motor-carrier tax receipts—Motor-fuel taxes, State (receipts from)—Motor-vehicle taxes, State (receipts from).	
of bedding courses of brick pavements	59			V	
of bituminous surface treatments or carpet coats	65			Van Wagoner, Murray D., a.	187-189
of bituminous wearing courses in nonskid treatment of roads	107, 109			Vehicle miles:	
of concrete pavements, practice	54			as standard for tax allocations	2
of stabilized soil roads and bases, thickness design	120			of travel on highways and relation of travel to highway expenditures, four States	17-30
				Ventilation of tunnels (highway), ventilation equipment	125, 127, 129-131, 133, 134, 139, 146-150

